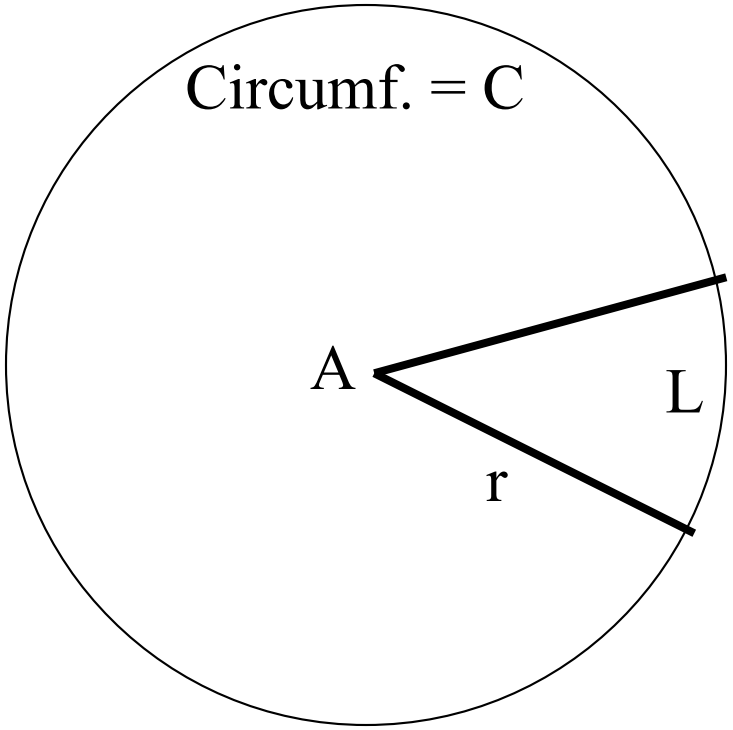
Angular Size of Fist

(If time permits….or later.)

- Work in pairs
- Need: string (about 2 m.) and protractor
- Hold fist with arm outstretched
- Loop string around fist with two ends meeting at your eye
- Angle formed with vertex at eye
- Measure angle with protractor

Angles in a circle

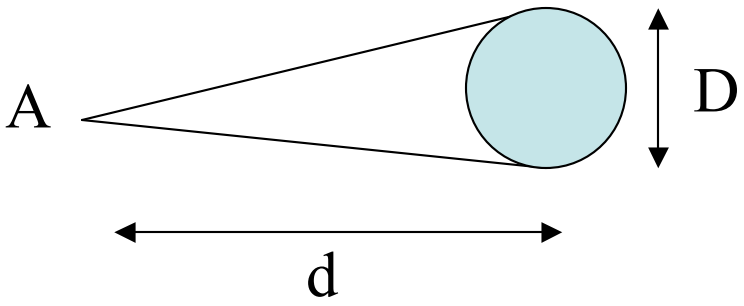


Angle A = (L/C) x 360 deg.

$C = 2\pi r$, $360/2\pi \sim 57.3$

Angle A ~ (L/r) x 57.3 deg.

Diameter/Distance Relationship



d = distance to the object

D = diameter of the object
(moon, sun, star, nebula, galaxy)

Angle A ~ (D/d) x 57.3 deg.

Note: This is called the “small angle approximation”

How large are the angles in Astronomy?

- Moon: Diameter = 3480 km, distance = 384,000 km
- Sun: Diameter = 870,000 miles, distance = 94 million miles
- Use the formula in the previous slide to calculate the angular sizes of the moon and the sun.

Calculations

(Do your work here.)

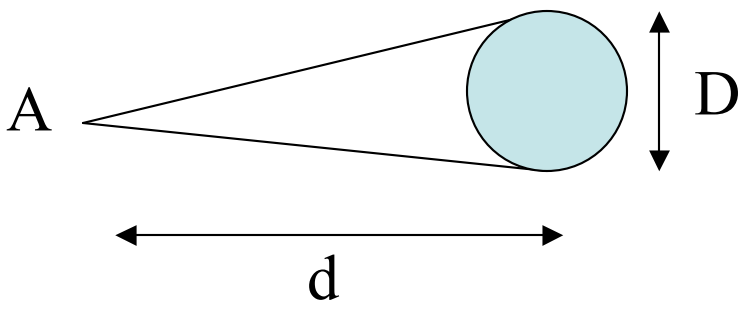
Angular size of the Moon:

Angular size of the Sun:

Angular units in Astronomy

- Moon and Sun our largest objects
- Need much smaller unit than the degree
- 1 hour = 60 minutes; 1 minute = 60 seconds
- 1 degree = 60 arcminutes; 1 arcminute = 60 arcseconds
- 1 degree = 3600 arcsecs (written 3600”)

The Small Angle Formula



The Small Angle formula becomes:

Angle A = (D/d) x 206,265

(A in arcseconds)

Angular Size of Jupiter

- Jupiter: Diameter = 142,000 km, distance = 5.2 AU from the sun
- Remember: Earth is 1 AU from sun……and 1 AU = 1.5×10^{11} meters.
- What's the angular size of Jupiter as viewed from the earth at "opposition" (when we're both on the same side of the sun)?

Calculations

(Do your work here.)

D = _____km.

d = ____AU = _____ km.

A =

= ___ arcsecs

How big is an arcsecond?

- Place one meter stick on top of another.
- Insert a sheet of paper between the sticks at one end.
- The angle formed is about 25 arcseconds!
- Compare this to Jupiter's angular size, but keep in mind that Jupiter is 630 billion meters away!

Plate Scale

- Open Images: Tracking Jupiter's Moons
- Open Jup5
- Determine the diameter of Jupiter in pixels using slice.
- PS (plate scale) = arcsecs/pixel
- Calculate the PS using previous calculation of Jupiter's angular size.

Calculations

(Do your work here.)

- Diameter of Jupiter = ____ pixels
- Angular size of Jup = ____ (from previous calc.)
- Plate Scale = _____ arcsecs/pixel

Using Plate Scale

- Click “log” on Jup5
- Measure distance to “Io” (lower left moon) from center of Jupiter using “slice”.
- Convert pixels to angle (“) using the PS you calculated earlier. **A = (PS) x (pixels)**
- Use small angle formula to calculate Io-Jupiter distance in km. Assume 4.2 AU for Earth-Jupiter distance.

Calculations

(Do your work here.)

- Io-Jupiter distance = _____ pixels
- Angle A = (PS) x (pixels) = _____ “
- d (Earth-Jupiter) = _____ km.
- D (Io-Jupiter) =

  = _____ km.

“A Grain of Sand”

- Open A2218 image (download if necessary from HOU website: galaxy cluster
- “A Grain of Sand” (APPRECIATE!)
- Calculate the angular size of the image using a “grain of sand” held at arm’s length (small angle formula).
- Measure the number of pixels across the A2218 image.

“A Grain of Sand” (con.)

- Determine the PS of this image. You have the arcsecs and the pixels.
- Measure the pixel size of a galaxy.
- Determine the angular size of the galaxy using the PS.
- Assume this galaxy is about the size of the Milky Way ~100,000 LY across.

“A Grain of Sand” (con.)

- You now know the angular size of this galaxy and can assume its actual diameter.
- Use the small angle formula to determine the distance to the galaxy in LY.
- Angle A = (D/d) x 206,265
- A bit of Algebra manipulation is required

Calculations

(Do your work here.)

- Angle A = _____ arcsecs (“)
- D = _____ LY
- d =

  = _____ billion LY